Low Mass Electromagnetic Plasmoid Thruster with Integrated PPU, Phase II

Completed Technology Project (2011 - 2014)

Project Introduction

The Electromagnetic Plasmoid Thruster (EMPT) is a revolutionary electric propulsion thruster and power processing (PPU) system that will allow a dramatic decrease in system mass and increase in thrust efficiency over traditional 500-3000 W propulsion systems. The high specific power (>700 W/kg) and high efficiency of EMPT will enable a wide range of deep space missions such as Neptune, Pluto and Oort Cloud orbital insertion. Additionally, a solar electric EMPT system would dramatically increase the capability and reduce the travel time of an asteroid or Martian moon sample and return mission due to the variable-power, low-mass propulsion system. The EMPT employs a Rotating Magnetic Field (RMF) to produce large plasma currents inside a conical thruster creating a plasmoid that is magnetically isolated from the thruster walls. The intensified gradient magnetic field from the plasmoid together with the large plasma currents result in an enormous body force that expels the plasmoid at high velocity. The EMPT is a pulsed device, nominally operating at 1 kWe with 0.5-1 Joule discharges at 1-2 kHz. Presented is a full description of the relevant plasma physics as well as the thruster and PPU design. The Phase I EMPT demonstrated the multi-pulse formation and ejection of plasmoids at 0.1-3 Joules and 500-6,000 s Isp on both Xenon and Argon. Additionally, it demonstrated zero erosion or life limiting phenomena. The focus of the proposal is the experimental validation of an integrated thruster and PPU operating in a steady-state mode. The EMPT will be characterized over a range of parameters: input power from 200-3000 Watts, and 1,500-4,000 seconds specific impulse. The integrated thruster and PPU to be built and tested will have a total system mass of less than 1.5 kg. Successful completion of Phase II will be a fully integrated, steady-state demonstration of thruster and integrated power processing. Phase II will mature the technology from a TRL level 4 to 6.

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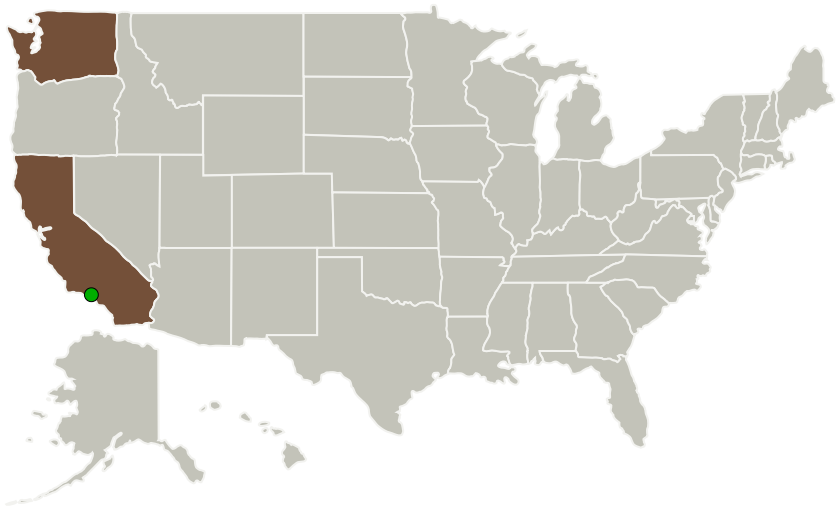
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
MSNW, LLC	Lead Organization	Industry	Redmond, Washington
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Washington

Project Transitions

June 2011: Project Start

January 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139049)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

MSNW, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

David Kirtley

Co-Investigator:

David Kirtley

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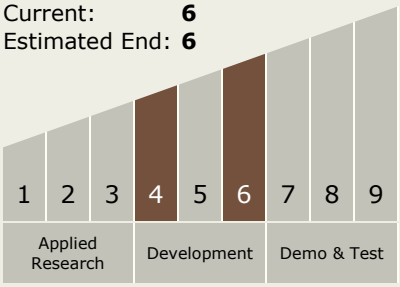
Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System